DESCRIPTION OF *ANISYNTA CYNONE ANOMALA* SUBSP. N. (LEPIDOPTERA: HESPERIIDAE) FROM THE NORTHERN TABLELANDS OF NEW SOUTH WALES, WITH A DISCUSSION OF ITS VARIATION, SYMPATRY WITH AND SIMILARITY TO *ANISYNTA TILLYARDI* WATERHOUSE & LYELL

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Abstract

A new subspecies of hesperiid, *Anisynta cynone anomala* subsp. n., from Torrington, Bluff Rock Mountain and Bolivia Hill, Dutchman's Tableland, northern tablelands of New South Wales, is described and distinguished from *Anisynta c. cynone* (Hewitson) from South Australia and Victoria, *A. c. gunneda* L.E. Couchman from Gunnedah, NSW and the similar *A. tillyardi* Waterhouse & Lyell. Both *A. c. anomala* subsp. n. and *A. tillyardi* are confirmed to occur at Bolivia Hill, where some specimens of *A. c. anomala* subsp. n. resemble those of *A. tillyardi*, suggesting possible hybridisation or convergence of the two species at this locality.

Introduction

Anisynta cynone (Hewitson, 1874) is a widely distributed skipper, occurring patchily in South Australia (Fisher 1978), western Victoria (Dunn and Dunn 1991, Field 2013), southern New South Wales (Braby 2000) and on the mountains and slopes of the Main Dividing Range in New South Wales (Common and Waterhouse 1981, Braby 2000). Four subspecies were recognised by Common and Waterhouse (1981): *A. c. cynone* and *A. c. gracilis* (Tepper, 1882) from South Australia, *A. c. grisea* Waterhouse, 1932 from Victoria and southwestern New South Wales, and *A. c. gunneda* L.E. Couchman, 1954 from Gunnedah and Mt Kaputar, New South Wales. Fisher (1978), when referring to variation in *A. cynone* from South Australia, indicated more material was needed to determine the subspecific status of *A. c. grisea*, while Dunn and Dunn (1991) noted that subspecies *gracilis*, *grisea* and *cynone* could not be separated without reference to the label data. Subsequently, Braby (2000) did not accept *A. c. grisea* or *A. c. gracilis* as valid subspecies but recognised *A. c. gunneda*, noting that specimens from Mt Kaputar, New South Wales, were not typical of that subspecies from Gunnedah, having a darker brown upperside and variable underside patterns. Specimens of *A. cynone* from Bolivia Hill, New South Wales, were noted by Dunn and Dunn (1991) to be larger than specimens of *A. c. gunneda* and the uppersides superficially resembled *A. tillyardi* Waterhouse & Lyell, 1912, while Braby (2000) noted that a female specimen of *A. cynone* from Bolivia Hill could not be distinguished from that sex of *A. tillyardi*. Evans (1949) provided images of male genitalia of *Anisynta* spp, showing slight differences between *A. cynone* and *A. tillyardi*. However, Braby (2000) considered the male genitalia of the two species to be indistinguishable. Sands (2009) considered the wingspans of specimens of *A. cynone* from Torrington, Dutchman's Tableland, to be similar to those of *A. tillyardi* and suggested

further taxonomic studies would be required to determine the status of specimens of *A. cynone* from Mt Kaputar, Torrington and Bolivia Hill.

Here we assign specimens of *A. cynone* from Torrington, Bluff Rock Mountain and Bolivia Hill, on the northern New England Tablelands of New South Wales, to a new subspecies, *A. cynone anomala* subsp. n. and distinguish it from *A. c. cynone* and *A. c. gunneda* from Gunnedah, NSW. We have not reviewed the status of *A. cynone* from Mt Kaputar, NSW but show that the forewing lengths of these specimens (Fig. 27) are not significantly different from those of *A. c. cynone* and *A. c. gunneda* from Gunnedah, but differ from those of *A. c anomala*. We confirm that *A. c. anomala* and *A. tillyardi* both occur at Bolivia Hill (G.R. Forbes pers. comm.). As proposed by Braby (2000), Sands and New (2002) and Sands (2009), we consider the following possibilities: (1) hybridisation between *A. c. anomala* and *A. tillyardi* at Bolivia Hill; (2) an established tension zone (*cf.* Barton and Hewitt 1985) involving the two species; or (3) convergence in *A. c. anomala* that might explain the occurrence of some specimens of *A. c. anomala* at Bolivia Hill that were previously considered to be hybrids.

Abbreviations: AMS – Australian Museum, Sydney; ANIC – Australian National Insect Collection, CSIRO, Canberra; NMV – National Museum of Victoria, Melbourne; QM – Queensland Museum, Brisbane; SAM – South Australian Museum, Adelaide; CGM – Grant Miller, private collection; GF – Graham Forbes, private collection, Brisbane; MCS – Michael Sands, private collection, Brisbane; FWL – forewing length.

Anisynta cynone anomala subsp. n.

(Figs 1-6, 23-24, 27, 28a-e, h)

Types. Holotype ♂, labelled 'NEW SOUTH WALES, Silent Grove Road, 1128 m, 4.0 km N. Torrington, 29°16'54"S, 151°41'08"E, 14 March 2008, M.C. Sands', in ANIC.

Paratypes: NEW SOUTH WALES: 12 ♂♂, Bolivia Hill, 36 km S Tenterfield, 8.iii.1986, J.F.R Kerr; 2 ♂♂, 5 ♀♀, same data except 9.iii.1986; 9 ♀♀, same data except 8.iii.1984, J. Kerr; 7 ♀♀, same data except 18.iii.1984; 1 ♂, 1 ♀, Bolivia Hill, 36 km S Tenterfield, 16.iii.1996, C.G. Miller; 1 ♀, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 12.iii.2008, M.C. Sands; 1 ♂, New England Highway, Bolivia Hill, 1215 m, 29°20'25"S, 151°54'31"E, 1.iv.2006, M.C. Sands; 1 ♂, Bolivia Hill, Tenterfield, 3.iii.1984, D.P.A. Sands, in ANIC; 1 ♂, 1♀, 29°15'59.1"S, 151°40'35.2"E, 6 km north of Torrington, 22.iii.2009, S.J. Johnson; 2 ♂♂, 2 ♀♀, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 14.iii.2008, M.C. Sands, in QM; 1 ♂, 1 ♀, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 12.iii.2008, M.C. Sands, in AMS; 1 ♂, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 14.iii.2008, M.C. Sands; 1 ♀, same data except 12.iii.2008, in NMV; 1 ♂, 1 ♀, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 14.iii.2008, M.C. Sands, in SAM; 2 ♂♂, 2 ♀♀, 4 km N Torrington, 17.iii.2013, C.G. Miller; 1 ♂, Bolivia Hill, 36 km S. Tenterfield, 16.iii.1983, C.G. Miller; 1 ♂, 1 ♀, same data except 23.iii.1983; 1 ♀, same data except 21.iii.1986; 1 ♀, Bolivia Hill, 37 km S

Tenterfield, 21.iii.1986, C.G. Miller, in CGM; 2 ♂♂, 4 ♀♀, Silent Grove Road, 1128 m, 4.0 km N Torrington, 29°16'54"S, 151°41'08"E, 12.iii.2008, M.C. Sands; 3 ♂♂, 8 ♀♀, same data except 14.iii.2008; 1 ♂, same data except iv.2006; 2 ♂♂, 1 ♀, same data except 1.iv.2007; 1 ♂, Bolivia Hill, 3.iii.1984; 2 ♂♂, 2 ♀♀, Silent Grove Road, 1080 m, 4.0 km N Torrington, 29°16'09"S, 151°41'08"E, 24.iii.2008, D.P.A.. Sands, in MCS.

Figs 1-6. *A. cynone anomala* subsp. n.: (1-2) Holotype ♂ (Torrington, NSW); (3-4) aberrant ♂ (Bolivia Hill); (5-6) Paratype ♀ (Torrington, NSW). (1, 3, 5) uppersides, (2, 4, 6) undersides.

Description. *Male* (Figs 1-4, 23-24). Antennal length (of holotype) 7.0 mm; shaft dorsally grey-black, segments edged narrowly white, ventral surface cream; club bowed beyond midpoint viewed dorsally, flattened viewed laterally, dorsally grey-black, basal half cream viewed ventrally, apical half

orange; eyes black, edged with white setae dorsally; palpus dorsally black, surrounded by long black and white setae, ventrally with long white setae; thorax and abdomen dorsally black with brown setae at posterior, ventrally light brown with long cream setae on thorax and abdomen terminal segments; legs light brown with sparse long white setae, mid tibia with two long, slender apical spurs, hind tibia with three spurs, two apical and one post median. Forewing length (of holotype) 13.8 mm**,** costa almost straight, weakly convex near base and R_3 to apex; apex acute; termen weakly convex; CuA_1 equidistant from M_3 and CuA_2, area between CuA_2 and 1A+2A, *ca* 1.5 x wider than CuA_1 and CuA_2, 1A+2A upwardly curved towards termen; cilia light brownish cream, narrowly dark brown at vein ends of R_5 to CuA_1, brown between CuA_2 and 1A+2A and tufted on inner margin. Upperside: forewing grey-brown, becoming dark brown towards termen, base to cell and area towards tornus, overlain with pale yellowish-brown scales, one prominent pale yellow spot towards apex of cell; three short rectangular sub-apical cream spots, crossed by dark brown veins at right angles to costa between R_4, R_5 and M_1, two narrower sub-terminal spots closer to termen between M_1 and M_3, a row of four post median larger spots, sub-parallel to termen, between veins M_3 to 1A+2A, with spots between CuA_2 and 1A+2A elongate above 1A+2A; hindwing base to 1/3 of costa convex, distal 2/3 almost straight; apex rounded, termen convex, inner margin almost straight, slightly concave beyond midpoint; hindwing upperside medium grey-brown, without spots or suffusion, base to median region overlain with pale yellowish-brown scales; cilia weakly chequered, $Sc+R_1$ to Rs grey-brown, Rs to CuA_2 cream, broadly brown at vein ends, narrowly cream 1A+2A to tornus. Forewing underside, costa broadly pale orange-brown from base to sub-apex, termen at apex broadly pale orange-brown, inner edge crenulated R_5 to M_3; three short sub-rectangular sub-apical cream spots between R_4, R_5 and M_1, aligned at right angles to costa; ground colour posterior to cell, dark brown from base to sub-apex and inner margin, reaching termen at tornus; two cream cell spots and two post-median spots between M_3 and CuA_1, CuA_1 and CuA_2; termen cream, broadly dark brown at vein ends R_5 to 1A+2A. Hindwing underside, ground colour orange-brown, a band of post median cream spots R_5 to 1A+2A, interrupted at veins, inwardly edged with a band of post median, elliptical reddish-brown spots ringed by brown, R_5 to 1A+2A; an elongate greyish-cream patch from base to sub-termen between M_1 and M_3, interrupted by two dark cell spots, two short cream patches between $Sc+R_1$ and Rs, separated by median dark brown spots, another between CuA_2 and 1A+2A, both patches at cell sub-triangular; apical half of inner margin fold 1A+2A to 3A, dark brown crossed by paler veins; marginal cilia $Sc+R_1$ to 1A+2A, broadly cream between veins and at tornus, narrowly brown at vein ends.

Male genitalia (Figs 28 a-e). Tegumen and vinculum ring wider basally than dorsally, rounded at saccus; saccus produced; base of tegumen-uncus broad,

hooded; uncus slightly inwardly curved, expanded posteriorly with two semi-circular lobes, separated by slightly concave margin, with dense fine setae on dorsal and lateral surfaces; gnathos with pair of broad sub-triangular ridged processes, broadest at base with sclerotized spinules; valva with ampulla and fold separate from harpe, apex of dorsal lobe projecting well beyond ventral lobe; rounded at apex and heavily developed sclerotized teeth, ventral lobe with broad basal fold, with separate distal fold curved upwards posteriorly with apex broad, rounded and edging teeth heavily sclerotized; apex of uncus, dorsal and ventral lobes with long setae; juxta with heavily sclerotized ventral plate, each lobe rounded, ventrally developed each side of orifice; aedeagus sub-tubular, with sheath slightly expanded near orifice.

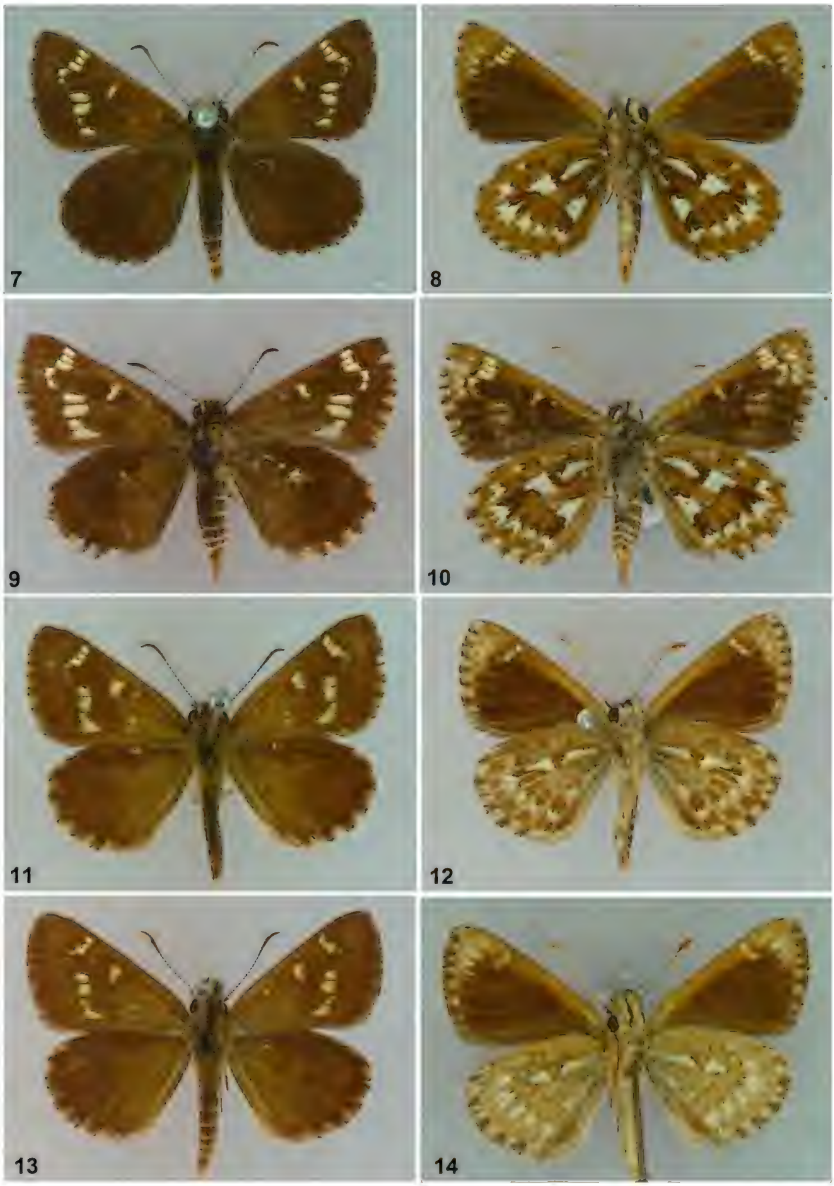
Female (Figs 5-6, 24). Similar to male, mostly with larger wingspans and upperside with larger and darker cream forewing spots, hindwing cilia more prominently chequered. Antennal length (Torrington paratype) 7.2 mm; shaft dorsally grey-black, segments edged narrowly white, ventral surface cream; viewed dorsally club bowed beyond midpoint, flattened laterally; dorsally grey-black, viewed ventrally basal half cream, apical half orange; eyes black, edged with white setae dorsally; palpus dorsally black, surrounded by long black and white setae, ventrally with longer white setae; thorax and abdomen dorsally black with brown setae at posterior, ventrally light brown with long cream setae on thorax and abdomen terminal segments; legs light brown with sparse long white setae, mid tibia with two long, slender apical spurs, hind tibia with three spurs: two apical and one post median. Forewing length (Torrington paratype) 13.5 mm**,** base of costa weakly convex, remainder almost straight; apex obtuse; termen weakly convex. Forewing upperside grey-brown, grading to dark brown towards termen, base to median area overlain with pale orange-brown scales, a prominent pale yellow spot near apex of cell, post-median and sub-terminal area with paler cream-yellow spots: three short sub-rectangular cream spots aligned and at right angle with costa between R_4, R_5 and M_1, a small post-median, pale yellow spot closer to termen between M_1 and M_2; four post median spots, sub-parallel to termen M_3 to 1A+2A, most prominent between M_3 and CuA_2; with elongate spot above 1A+2A smaller; cilia chequered cream apex to 1A+2A, brown at vein ends R_5 to 1A+2A and at tornus; Forewing underside with costa broadly pale orange-brown from base to apex, termen at apex broadly pale orange-brown, inner edge crenulated from R_5 to M_3; 3 short sub-rectangular sub-apical cream spots between R_4, R_5 and M_1, in a line at right angles to costa; ground colour posterior to cell dark brown, extending from base to sub-apex and inner margin, reaching termen at tornus; one large cream cell spot and two post-median spots between M_3 and CuA_1, and CuA_1 and CuA_2; termen cream, broadly dark brown at vein ends R_5 to 1A+2A. Hindwing costa (viewed from beneath) with basal 1/3 convex, distal 2/3 almost straight towards apex, apex strongly obtuse; termen convex, inner margin almost straight; underside, ground colour orange brown; sub terminal cream patches between $Sc+R_1$, M_3

and CuA_1, CuA_1 and CuA_2, and CuA_2 and 1A+2A; a row of irregular post median cream-brown spots, edged reddish-brown between cream patches, M_1 to 1A+2A; a sub terminal band of post median, oval or elliptical light brown patches, each ringed by dark brown, edged distally by a sub terminal band of irregular cream spots between veins $Sc+R_1$ and 1A+2A, and distally a sub-terminal band of brown patches reaching termen, separated narrowly by cream at veins, $Sc+ R_1$ to 1A+2A; apical half of inner marginal fold, 1A+2A to 3A, dark brown; cilia $Sc+R_1$ to 1A+2A moderately chequered, narrowly brown at vein ends, broadly cream between veins and at tornus.

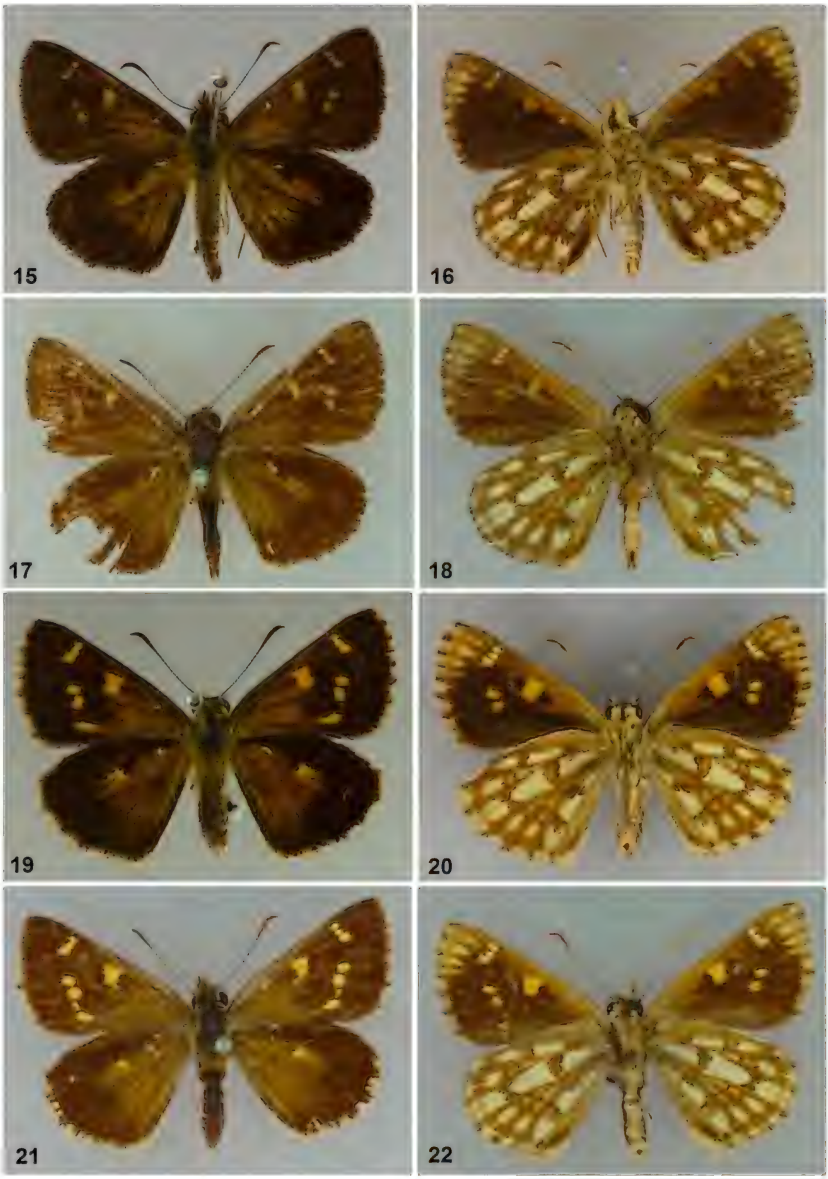
Female genitalia. (Fig. 28 h). Slide mounted: papillae anales cupped, apically tapered to blunt tip outwardly clothed in fine setae, apophyses posteriores long, slender, extending length of segment eight, segment eight with a broad ventral, bi-lobed sclerite, lobes flattened, slightly concave and similarly shaped, apically rounded, ostium bursae with post vaginalis rectangular sclerite with lateral edges rounded, strongly sclerotized, surrounded laterally by two slender, tapered sclerites; corpus bursae simple, membranous, not sclerotized.

Diagnosis. *Anisynta cynone anomala* subsp. n. (Figs 1-6) may be distinguished from *A. c. cynone* (Figs 7-10) and *A. c. gunneda* (Figs 11-14) by the greater wingspan of the former (for forewing lengths see Fig. 27) and the colour and pattern of spots on the underside of the hind wings (compare Figs 2, 4, 6, 23-24 with Figs 8, 10, 12, 14). On the upperside, the ground colour of most *A. cynone* subspp, including *A. c. anomala*, is grey-brown, but some specimens of *A. c. cynone* from South Australia are much darker (Fig. 7). The upperside forewing spots of *A. c. anomala* (Figs 1, 3, 5) are white to pale cream in males and yellowish in females, whereas those of *A. c. cynone* and *A. c. gunneda* are almost white or pale cream (Figs 7, 9, 11, 13). On the underside, the hindwing median spot and spots of the subterminal outer row are white and well defined in *A. c. cynone* (Figs 8, 10) but much less well defined and whitish cream in *A. c. gunneda* (Figs 12-13). In *A. c. anomala* the spots of the postmedian inner row are distinctly elliptical in shape, longer than wide, brown ringed by dark reddish brown (Figs 2, 6, 23-24); in *A. c. cynone* these are orange-brown, tipped by very dark brown towards the termen (Figs 8, 10); and in *A. c. gunneda* the spots are only slightly darker than the ground colour (Figs 12, 14).

Anisynta c. anomala subsp. n. may be distinguished from *A. tillyardi* (Figs 15-22) by its smaller wingspan (see Fig. 27), differences in ground colour, the shape of spots on the upperside (compare Figs 1, 3, 5 with Figs 15, 17, 19, 21) and the pattern of spots on the underside of the hind wings (Figs 23-26). On the upperside, both sexes of *A. c. anomala* are grey-brown, whereas the upperside of *A. tillyardi* is brown-black. *A. c. anomala* has the basal half of both wings obscurely overlain with yellowish brown scales, whereas both wings of *A. tillyardi* are overlain with orange-brown scales.



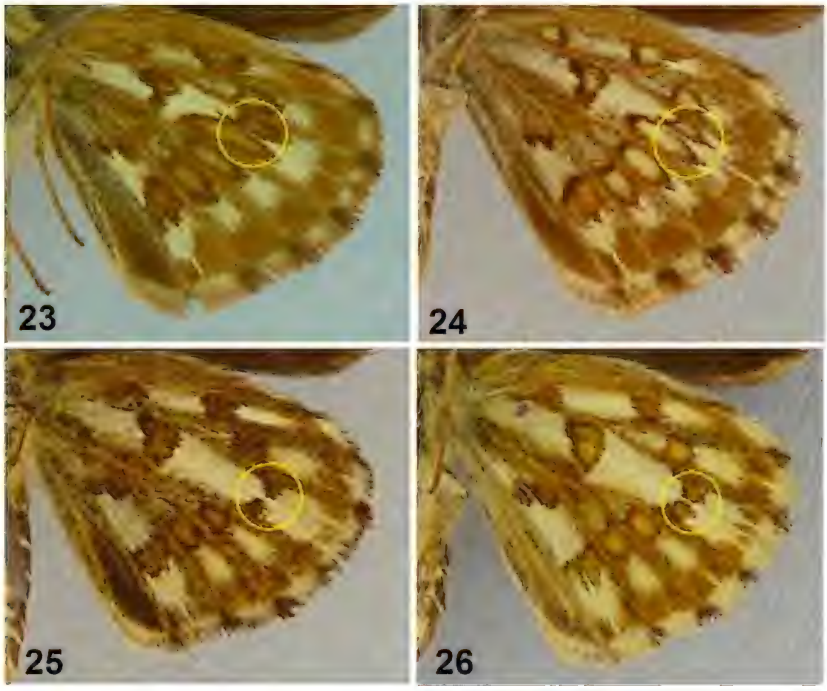
Figs 7-14. *Anisynta cynone* subpp: (7-10) *A. cynone cynone* (South Australia: Alexandrina); (11-14) *A. cynone gunneda* (NSW: Gunnedah); (7-8, 11-12) ♂♂, (9-10, 13-14), ♀♀. (7, 9, 11, 13) uppersides, (8, 10, 12, 14) undersides.



Figs 15-22. *Anisynta tillyardi*: (15-16) ♂, (19-20) ♀, Mt McKenzie, northern NSW; (17-18) ♂, (21-22) ♀, Bolivia Hill, northern NSW. (15, 17, 19, 21) uppersides, (16, 18, 20, 22) undersides.

The forewing spots of *A. c. anomala* are cream in males and slightly yellowish in females. On the underside of the hind wings of both sexes of *A. c. anomala,* the postmedian elliptical spots are longer than wide, whereas those of similarly placed spots in *A. tillyardi* are neither elliptical nor longer than wide.

The images of male genitalia figured by Evans (1949) show that the dorsal lobes of the valvae of *A. cynone* differ from those of *A. tillyardi.* We noted differences between valvae of *A. c. cynone* (Fig. 28f) and *A. tillyardi* (Fig. 28g), but the valvae of *A. c. anomala* (Fig. 28e) differed only slightly, with the dorsal lobe of *A. c. anomala* being somewhat narrower and more produced than the dorsal lobe of *A. tillyardi*. We could not distinguish differences in the female genitalia of *A. c. cynone* and *A. tillyardi*.



Figs 23-26. *Anisynta* spp, hindwing undersides: (23-24) *A. cynone anomala* subsp. n. (Torrington); (25-26) *A. tillyardi* (Mt McKenzie). (23, 25) ♂♂, (24, 26) ♀♀. Circle indicates position of differentiating spots.

Variation. Range of forewing lengths: ♂♂: 12.7-15.0 mm; ♀♀, 13.3-15.8 mm. In addition to differences in forewing lengths, variation in both sexes of *A. c. anomala* occurs in the size or presence of forewing spots and hindwing spots and patches on the underside. The forewing spots on the upperside of

some males of *A. c. anomala* subsp. n. from Bolivia Hill and rarely Torrington, may be small or obscure and closely resemble the pattern and size of spots of male *A. tillyardi* (see Diagnosis). On the upperside of the hind wings, females of *A. c. anomala* may sometimes have a central cell spot (C.G. Miller pers. comm.). The undersides of both sexes of *A. c. anomala* are variable but the areas of cream between veins M_1, M_2 and M_3, are smaller than those areas of *A. tillyardi* (see Diagnosis).

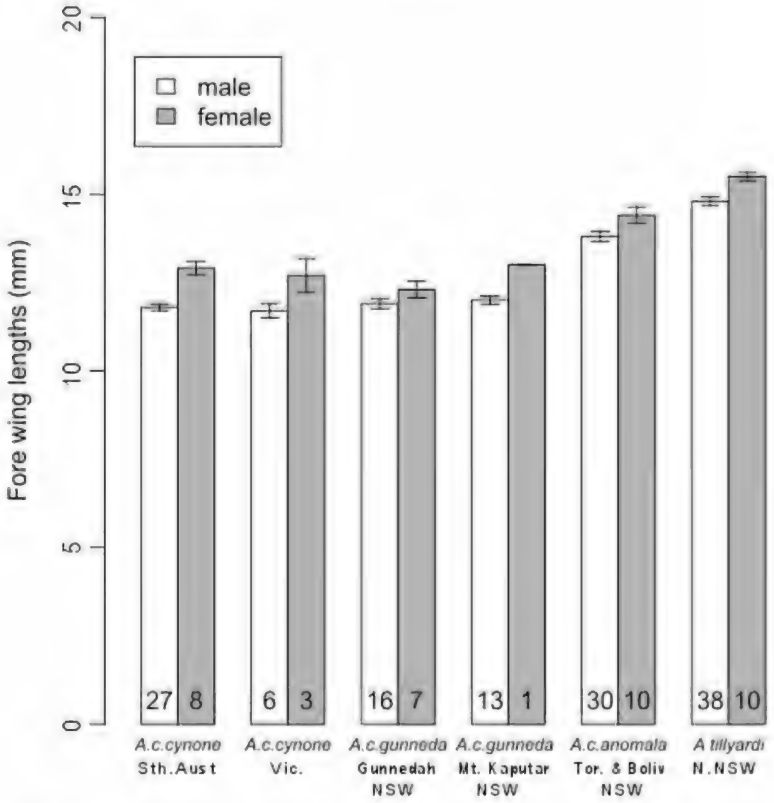


Fig. 27. *Anisynta cynone* subspp and *A. tillyardi*, forewing lengths (mm): ♂ and ♀ bars with number of specimens examined: *A. c. cynone* (South Australia: Alexandrina, Malinong, Ashville); *A. c. cynone* (Victoria: Kerang); *A. c. gunneda* (inland NSW: Gunnedah); *A. c. gunneda* (northern NSW: Mt Kaputar); *A. c. anomala* subsp. n. (northern NSW: Torrington, Bolivia Hill); *A. tillyardi* (northern NSW: Ebor, Mt McKenzie, Liston, Killarney).

Forewing lengths (mm) of a number of males and females of *A. cynone* subspecies and *A. tillyardi* (Fig. 27) were analysed. Two-way analysis of

variance of forewing lengths, using factors sexes and taxa, found both were significant (sex, $F_{1,158}$ = 33.60, p< 0.001; taxa, $F_{5,158}$ = 135.86, p<0.001; without interaction, $F_{5,158}$ = 0.88 NS). Hence, there was a constant difference between sexes for all taxa, with female forewings longer than males, estimated at 0.82 ± se 0.16. The LSD test identified three groups of forewing lengths for: (1) *A. c. cynone* (South Australia, 12.15 mm ± se 0.13; Victoria, 12.00 mm ± se 0.23), *A. c. gunneda* (NSW: Gunnedah, 11.86 mm ± 0.15 and Mt Kaputar, 12.30 mm ± se 0.31), with forewing lengths not significantly different; (2) *A. c. anomala* (NSW: Torrington, Bolivia Hill, 13.90 mm ± se 0.12), with forewings significantly longer than in *A. c. cynone* and *A. c. gunneda*; and (3) *A. tillyardi*, with forewings significantly longer than in *A. c. anomala.*

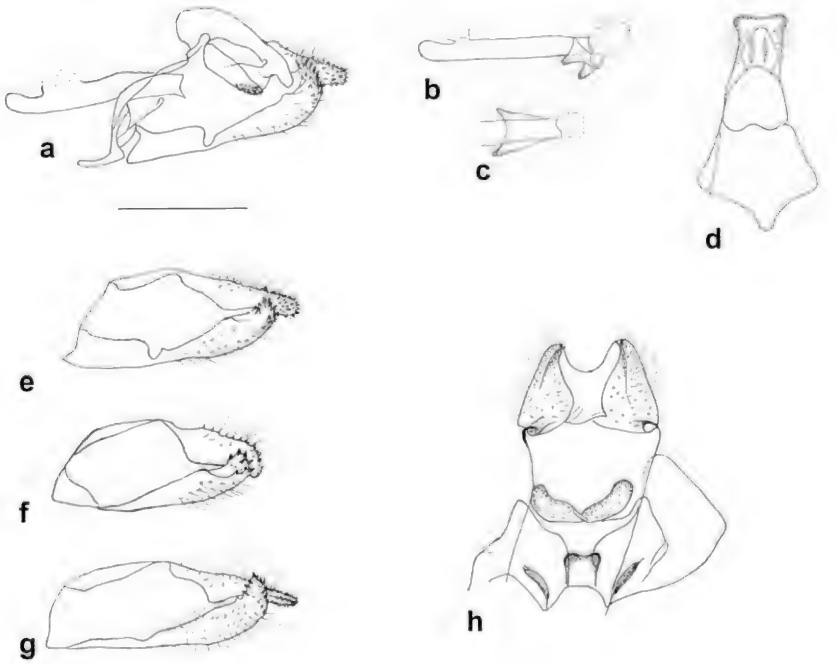


Fig. 28. *Anisynta* spp genitalia: (a-e, h) *A. cynone anomala* subsp. n. (Torrington); (f) *A. c. cynone* (South Australia); (g) *A. tillyardi.* (a-g) ♂♂: (a) undissected, lateral view; (b-c) aedeagus retracted, juxta at apex, (b) lateral view, (c) dorsal view; (d) uncus and tegumen, dorsal view; (e-g) valvae; (h) ♀: sclerites with terminalia, ventral view. Scale bar = 1 mm.

Distribution. New South Wales: Torrington, Dutchman's Tableland (Sands 2009), Bluff Rock Mountain (one specimen, J. Moss) and Bolivia Hill, South of Tenterfield.

Biology. At Mt Kaputar, inland NSW, larvae of *A. c. gunneda* are known to feed on *Austrostypa scabra* (Lindl.) S.W.L. Jacobs & J. Everett and *Poa* aff. *sieberiana* Spreng. (R. Mayo pers comm., Braby 2000). At Bolivia Hill, females of *A. c. anomala* have been observed ovipositing on a *Poa* sp. (C.G. Miller pers. com.), possibly *P. sieberiana,* but other possible food plants include *Austrostipa scabra*, *A. rudis* subsp. *rudis* (Spreng.) S.W.L. Jacobs & J. Everett, *A. rudis* subsp. *nervosa* (Vickery) S.W.L. Jacobs & J. Everett, *A. aristiglumis* (F. Muell.), S.W.L. Jacobs & J. Everett, and *A. ramosissima* (Trin.) S.W.L. Jacobs & J. Everett; (P. Grimshaw pers. comm.).

At Torrington, *Poa sieberiana* is abundant (P. Grimshaw pers. comm.), and likely to be a food plant for *A. c. anomala*. Other possible food plants for *A. c. anomala* at Torrington include *Austrostipa scabra, A. rudis* subsp. *rudis*, *A. rudis* subsp. *nervosa* and *A. verticillata* (Nees ex Spreng.) S.W.L. Jacobs & J. Everett (P. Grimshaw pers. comm.). *Poa labillardierei* is known to be a food plant for *A. tillyardi* (Atkins 1975) and is likely to be its food plant at Liston, Queensland, where *A. tillyardi* is very abundant. However, at Mt McKenzie where *A. tillyardi* is also abundant, *P. sieberiana* is the most common species of *Poa* (P. Grimshaw pers. comm.) and at Bolivia Hill, where *A. tillyardi* is not as abundant as *A. c. anomala,* a food plant of *A. tillyardi* might also be *P. sieberiana.*

The favoured habitats at both localities are undisturbed areas in eucalypt woodlands, where both sexes have been observed flying over patches of *Poa* spp. At the roadside at Bolivia Hill, adults of *A. c. anomala* have been observed visiting yellow daisies (J.F.R. Kerr pers. comm.), including *Xerochrysum bracteatum* (Vent.) Tzvelev, *Chrysocephalum apetulatum* (Labill.) Steetz. and at least one introduced species.

Discussion

The extent of occurrence of *A. c. anomala* is not known but the subspecies is thought likely to occur more extensively on the northwestern slopes near Tenterfield, New South Wales. With the possibility of a cline between populations of *A. c. anomala* and *A. c. gunneda*, the habitat, food plants and current lack of life history data have influenced our decision to describe this taxon as a subspecies of *A. cynone* and not recognise it as a distinct species. We have also taken into consideration the views of Braby *et al.* (2012) relating to the usefulness of the subspecies concept. Whereas adults of *A. c. anomala* prefer the dryer eucalypt woodlands on the western side of the Main Range and tablelands, *A. tillyardi* prefers moist woodlands on the eastern parts of the Main Range, except for the population occurring in moist woodland at Mt McKenzie at the western edge of its range. Whereas *A. tillyardi* occurs abundantly at Mt Mackenzie, it has not been found at Torrington, a western locality for *A. c. anomala*. Few specimens of *A. tillyardi* are known from Bolivia Hill but they include both sexes taken with *A. c. anomala* on the same day at the same locality (G. Forbes pers. comm.).

However, there may be some seasonal differences in times of appearance of adults of the two species at nearby localities: for example, *A. c. anomala* occurs mainly from mid March to early April at Bolivia Hill and at Torrington, whereas *A. tillyardi* is most abundant from mid February to early March, for example at Mount McKenzie (*ca* 25 km S of Bolivia Hill), north of Tenterfield and at several locations in northern New South Wales, including Liston.

Most specimens from Bolivia Hill previously thought to have been hybrids are males and have the forewing spots reduced in number, obscured by dark scales (*e.g.* Figs 3-4) or with some forewing spots absent. Very few males of *A. c. anomala* have the elliptical underside spots reduced but some, with undersides otherwise typical of *A. c. anomala,* have the forewing upperside darker than usual and resemble *A. tillyardi.* Based on the recent records of *A. tillyardi* from Bolivia Hill and specimens identical to those from Mt McKenzie, we consider that the female specimen mentioned by Braby (2000) might have been *A. tillyardi.*

The conservation significance of the population of *A. c. anomala* at Bolivia Hill was noted by Sands and New (2002) but it is doubtful that threats can be identified for either this area or the areas at Torrington, both now recognised as National (State owned) Parks. The similarity between some specimens of *A. c. anomala* and *A. tillyardi* at Bolivia Hill might be an example of convergence rather than hybrdisation. However, hybridisation is known in other closely related species of insects: for example, hybrids between tenebrionid beetles from Namibia occurred in areas where their habitats overlapped (Hamilton and Penrith 1977) and where hybridising continued despite maintenance of their specific integrity in nearby habitats. If hybridisation is occurring between *A. c. anomala* and *A. tillyardi* it might be limited to an area of overlap near Bolivia Hill, where *A. c. anomala* and *A. tillyardi* occur syntopically. We consider the population at Bolivia Hill might represent a tension zone (*cf.* Barton and Hewitt 1985), where both species occasionally hybridise but partially different seasonal emergence of adults has maintained the integrity of both species, despite some gene flow. This possibility might be resolved by future DNA studies in a way similar to those of Rougerie *et al.* (2012), with their studies on hybridisation of hawk moths in Tahiti. If hybridisation is shown to occur, the population of *A. c. anomala* at Bolivia Hill might represent a Tension Zone involving overlap in the distributions of *A. c. anomala* and *A. tillyardi*, as described by White *et al.* (1969) for grasshoppers on Kangaroo Island in South Australia.

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